CURRICULUM

OF

METALLURGY AND MATERIALS ENGINEERING

BS/BE/BSc
&
MS/ME/MSc

2012

HIGHER EDUCATION COMMISSION
ISLAMABAD
CURRICULUM DIVISION, HEC

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Mr. Muhammad Javed Khan  Adviser (Academic)
Malik Arshad Mahmood  Director (Curri)
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Mr. Abdul Fatah Bhatti  Asst. Director (Curri)

Composed by Mr. Zulfiqar Ali, HEC Islamabad
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The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “Supervision of Curricula and Textbooks and Maintenance of Standard of Education” the erstwhile University Grants Commission was designated as competent authority to develop, review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

A committee of experts comprising of conveners from the National Curriculum Revision Committees of HEC in the disciplines of Basic, Applied, Social Sciences, Agriculture and Engineering met in 2007 & 2009 and developed the unified templates to standardize degree programmes in the country so as to bring the national curriculum at par with international standards, and to fulfill the national needs. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for Metallurgy and Materials Engineering. The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

MUHAMMAD JAVED KHAN
Adviser (Academics)

April, 2012
CURRICULUM DEVELOPMENT

STAGE-I

CURRICULUM UNDER CONSIDERATION

COLLECTION OF EXP NOMINATION UNI, R&D, INDUSTRY & COUNCILS

CONS. OF NCRC.

PREPARATION OF DRAFT BY NCRC

STAGE-II

CURRICULUM IN DRAFT STAGE

APPRASIAL OF 1ST DRAFT BY EXP

FINALIZATION OF DRAFT BY NCRC

FINAL STAGE

PREPARATION OF FINAL CURRICULUM

PRINTING OF CURRICULUM

FOLLOW UP

QUESTIONNAIRE

COMMENTS

REVIEW

IMPLEMENTATION OF CURRICULUM

ORIENTATION COURSES BY LI, HEC

BACK TO STAGE-I

Abbreviations Used:
NCRC. National Curriculum Revision Committee
VCC. Vice Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
LI Learning Innovation
R&D Research & Development Organization
HEC Higher Education Commission
Introduction
The National Curriculum Revision Committee (NCRC) of Metallurgy and Materials Engineering had two meetings held on 16-18 November 2011 and 14-16 March 2012 at the Higher Education Commission Regional Centre, Karachi to revise and develop the curriculum for BE/BS and ME/MS degree programme. The committee consisted of the following members:

1. Prof. Dr. Fazal Ahmad Khalid, SI  
   Pro-Rector (Academic)  
   GIK Institute of Engineering Sciences and Technology, Topi  
   Khyber Pakhtunkhwa  
   Convener

2. Prof. Dr. Mohammad Mujahid  
   Dean and Principal  
   School of Chemical and Materials Engineering (SCME), NUST  
   Sector H-12, Islamabad  
   Member / Secretary

3. Prof. Dr. Muhammad Nasim  
   Department of Metallurgical & Materials Engineering, Dawood College of Engineering & Technology, MA Jinnah Road  
   Karachi – 74800
   Member

4. Prof. Dr. M. Saleem Shuja  
   Rector  
   The University of Lahore, Lahore
   Member

5. Prof. Dr. M Hayat Jokhio  
   Department of Metallurgy and Materials Engineering  
   Mehran university of Engineering and Technology  
   Jamshoro, Sindh
   Member

6. Dr. Muhammad Faisal Rathore  
   Manager (NESCOM Nominee)  
   Project Management Organization (PMO)  
   Expert Engineering, Opposite EME College  
   Peshawar Road, Rawalpindi
   Member

   Assistant Professor  
   Department of Materials Engineering  
   NED University of Engineering & Technology  
   University Road, Karachi - 75270
   Member
Mr. Muhammad Javed Khan, Adviser, Academics Division, Higher Education Commission (HEC) welcomed the members and participants to the meeting. He briefed the members on the academic programme and activities of the Higher Education Commission (HEC) and highlighted the important aspects related to national policy and guidelines for revision of curricula in all disciplines.

Prof. Dr. Fazal Ahmad Khalid, SI, the Convener thanked the Higher Education Commission (HEC) and members for providing an opportunity to participate and contribute in the revision of curriculum on Metallurgy and Materials Engineering. He highlighted the important benchmarks and international best practices to be considered for the development of the curriculum. He also suggested that the Committee comprising professors and experts from academia, industry and R&D institutions will provide a useful input and suggestions to incorporate in the curriculum. He also highlighted the importance of the field of materials engineering for development of new and advanced materials and mineral processing for economic development of the country. It is envisaged that the revised curriculum will provide
universities broad guidelines and benchmark to adopt in certain fields of specializations and research, for the education and training of graduates and engineers.

PROGRAMME AND EDUCATIONAL OBJECTIVES

The main objective of this curriculum is to provide the guidelines for the following programs:

1. Metallurgy & Materials Engineering
2. Materials Engineering
3. Metallurgical and Materials Engineering
4. Metallurgical Engineering

The graduates are expected to demonstrate knowledge, competence and expertise in materials and metallurgical processes, structure-property relations, design and analytical techniques. Graduates should also have following attributes:

- Strong fundamental background
- Broad based engineering knowledge
- Problem solving approach
- Suitability to work effectively in the industry
- Dynamic leadership, effective communication skills, high moral values and good engineering ethics.
- Creative and innovative thinking for research and development.
- Sufficient skills to optimise human, technological and natural resources

PROGRAMME LEARNING OUTCOMES

The curriculum has been reviewed in order to produce academically sound graduates for being successful in industry, research and development, international companies. Apart from the engineering courses a sufficient number of courses in English language, communication skills, ethics, social and management sciences have been incorporated into the curriculum to enhance the quality and performance of the graduates.

It is also expected that having followed this curriculum, the graduates would be sufficiently equipped to successfully pursue post-graduate studies.

SALIENT FEATURES

The curriculum revision is based on following considerations:

The undergraduate programme has been revised on the basis of HEC and PEC directives. The salient features of the revised curriculum are given below:

<table>
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<th>Duration:</th>
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<tr>
<td>Number of Semesters:</td>
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<td>Number of weeks per semester:</td>
<td>18 (16 for teaching and 2 for</td>
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</table>
Total number of credit hours: 136
Number of credit hours per semester: 15 – 18
Engineering Course: 69.12
Non-Engineering Course (Maximum): 30.88

This entire curriculum has been designed on the following lines:

- The curriculum matrix is composed of the foundation, breadth and depth courses so that different streams for specializations can be developed within each discipline.
- Foundation courses: The foundation courses are the compulsory courses. These courses provide students with the fundamental concepts and tools to pursue their studies at the higher level.
- Breadth Courses: The breadth courses introduce different specialties in the given discipline of engineering early in their studies comprising courses related to major based core breadth (MBCB) and Interdisciplinary engineering breadth courses (IDEB).
- Depth Courses: The depth courses offer various streams within each programme. All depth courses must integrate a substantial design component.
- The students may select electives from any of the streams with some guidelines from their respective advisors.
- All courses are also identified as engineering or non-engineering.
- A university can offer a degree programme in:
  - Metallurgy & Materials Engineering
  - Materials Engineering
  - Metallurgical and Materials Engineering
  - Metallurgical Engineering

The universities/institutions may opt for a particular engineering programme (1-4) considering the mission of the programme learning outcomes (PLOs) and availability of faculty and requisite lag facilities and infrastructure.
This curriculum has been designed to facilitate the universities to formulate their programmes according to the industrial needs and recent development in the field of Materials Science and Engineering.

### FRAME WORK TEMPLATE FOR BE/BSc/BS METALLURGY AND MATERIALS ENGINEERING

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<th>Knowledge Area</th>
<th>Subject Area</th>
<th>Name of Course</th>
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<th>Lab CH</th>
<th>CR</th>
<th>Total Courses</th>
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In the existing curriculum matrix, the labs are attached with the courses however, the universities may have the flexibility to combine different experiments of the semester as an independent lab course with appropriate credit hours.
# Scheme of Study
for BE/BSc/BS Metallurgy and Materials Engineering

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<tr>
<th>Course Title</th>
<th>Lec</th>
<th>Lab</th>
<th>CR</th>
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Title of the Course: **English-I (Functional English)**  
Credit Hours: 3-0-3  
Course Outline: Annex-A

Title of the Course: **English-II (Communication Skills)**  
Credit Hours: 3-0-3  
Course Outline: Annex-A

Title of the Course: **English-III (Technical Report Writing and Presentation Skills)**  
Credit Hours: 3-0-3  
Course Outline: Annex-A

Title of the Course: **Pakistan Studies**  
Credit Hours: 2-0-2  
Course Outline: Annex-B

Title of the Course: **Islamic Studies/ Ethics**  
Credit Hours: 2-0-2  
Course Outline: Annex-C  
Lab Outline: N/A  
Recommended Books:

Title of the Course: **Social Science (Social Psychology and Human Rights)**  
Credit Hours: 3-0-3  
Pre-requisites:

**Specific Objectives of Course:** The impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.

**Course Outline:**  
Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups, basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes, language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social
identities, conformity, group influence, moral and ethical issues, harassment, corruption and its control, thinking processes and decision making.

**Lab Outline:** N/A

**Recommended Books:**
- Lesko, W.A. “Readings in social psychology General, classic, and contemporary selections, 6th ed., 2006

**Title of the Course:** Social Science (Engineering Economy)
**Credit Hours:** 3-0-3

**Pre-requisites:**

**Specific Objectives of Course:** To impart knowledge of engineering economy.

**Course Outline:**
Introduction of engineering economy and the economic environment. Consumer and producer goods, measures of economic worth, Price, Supply, & Demand relationship; Production; Factors of production; Laws of return. Cost Concepts & Analysis: Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Unit cost of production. Time Value of Money: Simple interest; Compound Interest; Cash flow diagrams; Interest formulas; Nominal versus effective, interest rates; Depreciation and Depletion: Purpose of depreciation; Types of depreciation; Production Concepts & Mathematical Models: Manufacturing lead time, Production rate; Capacity; Utilization; Availability; Work in process; Linear Programming: Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems. Capital Financing and Budgeting: Types of ownership; types of stock; partnership & joint stock companies; Banking & specialized credit institutions. Industrial Relations: Labour problems; Labour organizations; Prevention & Settlement of disputes.

**Lab Outline:** N/A

**Recommended Books:**
Title of the Course: Industrial Safety and Environmental Engineering
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide thorough knowledge of industrial safety and engineering environment.

Course Outline:

Lab Outline: N/A

Recommended Books:
Title of the Course: Production Operations Management
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide insight in the management skills to the engineers working in the production industry.

Course Outline:
Production /operation functions and the organization. Basic concepts of five Ps . Production strategies, guides and unities. Decision making in operations. Planning and controlling operations. Operational budget making and controlling. Variety management. Quality control and quality management. TQM.
Location, design and layout of plant and equipment. Maintenance of equipment.
Methods study and work measurement. The importance of forecasting in production and operations control. Project management techniques. Personnel management. Health and safety management in industry

Lab Outline: N/A

Recommended Books:

Title of the Course: Environmental Management and Control
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of environmental management and its control.

Course Outline:

Lab Outline: N/A

Recommended Books:
- Christopher J. Barrow, “Environmental Management & Control” Rutledge, 2006

Title of the Course: Solid Waste Management
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide knowledge of solid waste management produced by materials industry.

Course Outline:
Solid wastes definitions, characteristics and perspectives. Types of solid wastes, sources of solid waste management. Engineered systems for solid waste management Solid waste generation, on site handling, storage and processing. Collection of solid wastes, Transfer and transportation, processing techniques, ultimate disposal. Engineered systems for resource and energy recovery, processing techniques, materials recovery of biological conversion products, recovery of energy from conversion products and energy recovery systems. Plastic waste, composition quantities and disposal alternatives. Recycling of wastes, recycling of plastics, metals and glasses.

Lab Outline: N/A

Recommended Books:
- Elizebeth, M Thomas-Hope “Solid Waste Management” 1998
Title of the Course: **Metallurgical Plants and Quality Control**  
Credit Hours: 3-0-3  
Pre-requisites:  

**Specific Objectives of Course:** To provide knowledge of metallurgical plants and the quality control procedures used.

**Course Outline:**  

**Lab Outline:** N/A

**Recommended Books:**  
Title of the Course: **Applied Physics**
Credit Hours: 3-1-4
Pre-requisites:

**Specific Objectives of Course:** To provide in-depth knowledge of the subject.

**Course Outline:**
Thermometry, heat transfer, heat insulation, properties of materials for use in building geometrical optics, the focal length of a lens, magnification, compound lenses, resolving power, laws of illumination and photometry, sextant spectrometer. Principles of refracting telescope, polarization of light. Waves and oscillation, sound waves, resultant to two simple harmonic motions, response and beats, acoustics and its application, interference, wave length and frequency, units and measurement of intensity, reflection and refraction of sound, reverberation time. Magnetic effect of current, CGS and practical units, relation between magnetism and electricity, magnetic field due to current in a long wire, force on a current carrying conductor in magnetic field, laws of electromagnetic induction, galvanometer, ammeter, voltmeter, avometer, condensers and dielectrics. Magnetic materials, B-H curves, hysteresis, magnetic circuits calculations, solenoids, pull of an electromagnet, principles of diode & triode, cathode ray tube and photomultiplier tube. Atomic & nuclear physics, atomic structure, nuclear structure, radioactivity, nuclear theory, fission & fusion.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

Journals/Periodicals
World Wide Web

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Title of the Course: **Calculus**
Credit Hours: 3-0-3
Pre-requisites:

**Specific Objectives of Course:** To build the basic calculus and analytical geometry background.
Course Outline:
Basic Operations of complex numbers, De'Moivre’s Theorem with applications, Circular, Hyperbolic, Exponential Functions of complex numbers and their inverse functions.


Lab Outline: N/A

Recommended Books:

Title of the Course: Differential Equations, linear algebra and Applied Techniques
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: Develop fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems.

Course Outline:
Applications of simple convergence tests such as comparison, root, ratio, Raabe’s and Gauss’ tests on the behaviour of series. Definitions, formation and solution. Boundary conditions. Homogeneous and Non-homogeneous linear differential equations with constant coefficients, linear equations will variable coefficients. Cauchy’s and Legendre’s equations. Equations of second order. System of simultaneous linear equations with constant

Lab Outline: N/A

Recommended Books:
Title of the Course: Applied Chemistry  
Credit Hours: 3-1-4  
Pre-requisites:  

Specific Objectives of Course: To provide thorough understanding of chemistry which is essential for Materials/Metallurgical engineers.

Course Outline:  

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:  
- Thodore E. Brown, “Chemistry”, Prentice Hall, 2005  

Journals/Periodicals World Wide Web

Title of the Course: Statistical Methods & Estimation  
Credit Hours: 3-0-3  
Pre-requisites:  

Specific Objectives of Course: To introduce the concept of statistics, randomness and probability and build on these concepts to develop tools and techniques to work with random variables

Course Outline:  
Statistical treatment of data, frequency distribution and graphs, measures of central tendency, measures of variation. Probability, samples, spaces and
events, counting probability, the axioms of probability, some elementary theorems, conditional probability, Bay's theorem, mathematical expectation and decision making. Probability distribution, random variables, the binomial distribution, Poisson approximation to the binomial distribution, Poisson processes, probability densities, normal distribution, statements “T” distribution. Sampling distribution, populations and samples. Curve fitting regression analysis by least square method, correlation, linear, polynomial, power, regression analysis by least square method, incorporation of linear polynomial, exponential or power function. Correlation coefficient of determination. Application and exponential model of reliability and life testing.

Lab Outline: N/A

Recommended Books:

- Jyotiprasad Medhi “Statitical Methods”, New Age Publishers, 2005,
  John Wiley & Sons, 2001

Journals/Periodicals
World Wide Web

Title of the Course: Introduction to Computing
Credit Hours: 2-1-3
Pre-requisites:

Specific Objectives of Course: This course focuses on a breadth-first coverage of computer: introducing software engineering and information technology.

Course Outline:
Number Systems, Binary numbers, Boolean logic, History and basic components of computer system, approaches to solving problems using computers, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, basic elements of C++ language, programming practice and case studies Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and internet, Computer graphics, AI, Social and legal issues.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:


Journals/Periodicals
World Wide Web

Title of the Course: Numerical Analysis
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To enable students using structured programming techniques in suitable programming languages and implement numerical solutions using computer-based techniques.

Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
• Mathew and Fink, “Numerical Methods” Prentice Hall, 2004
• Chopra and Canale “Numerical Methods for Engineers” McGraw-Hill, 2009

Journals/Periodicals
World Wide Web
Title of the Course: **Computer Application in Materials Engineering**

Credit Hours: 2-1-3

Pre-requisites:

**Specific Objectives of Course:** To provide knowledge of applications of computer in Materials engineering.

**Course Outline:**
Basic computer modelling and simulation techniques, Computer modelling and simulation of blast furnace and basic oxygen converter operations. Computer modelling for microstructures, Phase transformation, mechanical properties and materials processing including rolling, forging, casting, extrusion and machining operations. Use of computer software such as MATLAB, solidcast, magma, material studio, MTdata, CALPHED, FEM software such as ANSYS, ABACUS.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**
- Tetsuya Saito, “Computational Materials Design”, December 2010

Journals/Periodicals
World Wide Web
Title of the Course: Engineering Drawing and Graphics  
Credit Hours: 2-1-3  
Pre-requisites: 

Specific Objectives of Course: To provide in-depth knowledge of engineering drawings and graphics.

Course Outline: 
Introduction to subject, use of instruments, Planning of drawing sheets, the projection of simple solids in simple position, the oblique and auxiliary plans, lettering, dimensioning, the principle requirement of working drawing. Geometrical drawing & graphics: Isometric and pictorial of solid figures, making of free hand sketches from solid project and from orthographic projections. Section of solid, tangent planes, two surface in contact, intersection of surface and interpretation of solids development of surfaces. Machine drawing: Screw thread systems, keys and cutters, coupling and simple bearings, hanger, wall bracket, pipes and pipes fittings, shafts, connecting rods, piston and piston rod, valves stuffing boxes, pulling thread gearing.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Title of the Course: Workshop Practice  
Credit Hours: 1-1-2  
Pre-requisites: 

Specific Objectives of Course: To impart knowledge of workshop techniques.

Course Outline: 
Bench fitting: Description, proper use and maintenance of the fitting tools: use and care of measuring instruments, Preparation of some specific jobs. Forging: Hand forging, Use and maintenance of forging tools, the fore anvils, hammers, chisels, fullers, swages, punches, drifts, tongs, Prepare some specific jobs using forging methods. Use of power hammer, drop and press forging, riveting. Wood working: Use & care of wood working tools, clamps, saws, planes, files, rasps, chisels, drills, bits, planning, nailing, screwing, jointing, doweling. Use and care of natural wood, chipboard, plywood,
hardboard etc. Safety and care: Precautions necessary in many shops machine accidents, general cleanliness of shop, proper appraisal, accident alarms and evacuation.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**
- Raymond Francis Yates “Model Making Including Workshop Practice” The Norman W. Henley publishing company, 2007

**Journals/Periodicals**

**World Wide Web**

**Title of the Course:** Introduction to Engineering Materials  
**Credit Hours:** 3-0-3  
**Pre-requisites:**

**Specific Objectives of Course:** To introduce type of materials used in engineering.

**Course Outline:**
Introduction to engineering materials, their scope and role in industrial development, raw materials for engineering materials: their availability and demand, Atomic bonding, Crystal structures of metals, Introduction to polymers, ceramics and composite materials. Processing, properties and applications of metallic, polymeric, ceramic and composite materials. An introduction to new breeds of engineering materials e.g., shape memory materials, smart materials, biomaterials, electrical, magnetic and optical materials. Materials of aerospace and transportation industries.

**Lab Outline:** N/A

**Recommended Books:**
Title of the Course: Mechanical Behaviour of Materials
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To develop knowledge of mechanics of materials.

Course Outline:

Lab Outline: N/A

Recommended Books:
New Course: Engineering Mechanics
Credit Hours: 3-0-3

Statics of Particles:
Forces in a plane; Newton’s First Law, Free body diagram; Forces in space (rectangular components); Equilibrium of a particle in space.

Kinematics of Particles:
Rectilinear and curvilinear motion of particles; Components of velocity and acceleration; Motion relative to a frame in translation.

Kinetics of Particles:
Newton’s Second Law; Dynamic equilibrium; Rectilinear and curvilinear motion; Work and energy; Kinetic energy of particle; Principle of Work and Energy; Conservation of energy; Impulse and momentum; Impulsive forces and conservation of momentum; Impact, direct and oblique; Conservation of angular momentum.

Rigid Bodies:
Equivalent systems of forces; Principle of transmissibility; Moment of a force; Couple; Varignons Theorem. Centre of gravity of a three-dimensional body and centroid of a volume. Moments of inertia, radius of gyration, parallel axis theorem.

Equilibrium of Rigid Bodies:
Free-body diagram; Equilibrium in two and three dimensions; Reaction of supports and connections; Equilibrium of two-force and three-force bodies.

Kinematics of Rigid Bodies:
General Plane motions; Absolute and relative velocity and acceleration.

Plane Motion of Rigid Bodies:
Forces and acceleration; Energy and momentum; Conservation of linear and angular momentum.

Friction:
Laws of dry friction; Angles of friction; Wedges; Square-threaded screws; Journal and thrust bearings; Belt friction.

Analysis of Structures:
Internal forces and Newton’s Third Law; Simple and space trusses; Joints and sections; Frames and machines. Forces in cables.
Recommended Books:

Title of the Course: Physical Metallurgy-I
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To develop understanding of physical metallurgy of materials.

Course Outline:
- Generation of x-ray diffraction methods, Stereo graphic projections,
- Generation of x-ray, Crystallography, crystal defects (point defects, line defects) and their importance,
- Crystallography; Space lattice, Crystal system, Unit cell, Packing density, Coordination number, Allotropy, Rotational and Reflection Symmetries, Crystal planes and direction, Crystalline defects, Twining, Ordered and Disordered solutions. Crystallization; Solidification, Grain boundaries, Grain size,

Recommended Books:
Physical Metallurgy II

Credit Hours: 3-1-4


Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
• Cahn and Haasen, “Physical Metallurgy” 2001

Journals/Periodicals
World Wide Web
Title of the Course: Materials Thermodynamics
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course:

Course Outline:

Lab Outline:N/A

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Inspection and Testing of Materials
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of inspection and testing of materials

Course Outline:
Introduction to inspection and testing of materials, its scope and importance, The Brinell test, the Vicker test, the Rockwell test, the Knoop test, the
Scleroscope test, conversion tables for various scales of hardness, Stress and strain, load extension diagrams, modulus of elasticity, elastic limit, yield stress, proof stress, work hardening, tensile testing, (equipment and specimens). Compression testing, bend testing, torsion testing, impact testing. Toughness, brittleness and ductility, notched bar impact testing, the Charpy and Izod impact tests, brittle and ductile fractures, The fatigue test, different types of fatigue fractures, Goodman diagram, endurance limit-ultimate tensile strength, The Creep Test. Non destructive testing of materials, Liquid Penetrant, Eddy Current, X ray, Magnaflux, Ultrasonic, Radiography. ASTM, ASME, ISO standards and certifications and practices used for materials testing and inspection.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory.

**Recommended Books:**

**Journals/Periodicals World Wide Web**

**Title of the Course:** Instrumentation and Control
**Credit Hours:** 3-1-4
**Pre-requisites:** -

**Specific Objectives of Course:** To provide knowledge about the instrumentation and control systems used in materials and metallurgical engineering

**Course Outline:**
The functional elements of instruments, Pyrometry, Active and passive transducers, Calibration, Accuracy, Sensitivity, Threshold, Resolution, Hysteresis and Dead Space, Linearity, Permanent Magnet Moving coil instrument, Pen recorder, Cathode ray Oscilloscope, Transistor as Amplifier, Measuring instruments for motion, pressure, level, temperature and heat flux, Optical pyrometers, rheotubes, temperature recorders, digital portable temperature indicators, analog temperature controllers, types of

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Randy Slone, G., “Electricity and Electronics” McGraw-Hill ,2000,
World Wide Web

Title of the Course: Heat Treatment
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course:

Course Outline:
Phase diagram and their applications, Effect of common alloying additions on the equilibrium diagram. Annealing, normalizing, oxidation and decarburization during heat treatment, quenching rates and quenching media, martensitic transformation, TTT diagrams, effects of austenizing, grain size and alloying element on the transformation diagram, CCT diagrams. Hardenability, austempering, martempering. Induction and Flame hardening, heat treatment of cast iron, heat treatment of non ferrous metal and alloys, age hardening/precipitation hardening, defects caused during heat treatment and their remedies and subzero treatment, surface treatment and surface engineering.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
Title of the Course: Engineering Ceramics and Glasses
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: to understand processing, design composition, learn about microstructure-property relationship of ceramic materials.

Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Kingery, Bowen, Uhlmann “Introduction to Ceramics” Wiley, 1976
- Rice, R. W., “Ceramic Fabrication Technology”, Marcel Dekker, 2003
- Richerson, D. W., “Modern Ceramic Engineering”, Marcel Dekker, 2000
Title of the Course: Manufacturing Technology
Credit Hours: 3-1-4

Pre-requisites:

Specific Objectives of Course: To understand manufacturing processes available for materials.

Course Outline:
Scope and importance of manufacturing technology in Pakistan, Classification of mechanical working processes, Stamping and Deep Drawing, Weldability, work hardening, forging, tube drawing, sheet metal forming process, machining, rolling principles, rolling of ingot, bloom, billets, sheet and structural components, rolling of bars and rods, thermo-mechanical Treatment, rolling mills design and calculations, manufacturing process and system design, manufacturing defects causes and remedies, quality control in manufacturing processes, CAD/CAM technology. Introduction to Non-conventional manufacturing processes such as water jet cutting, and plasma cutting. Tool design. Surface Measurement and inspection, telesurf tolerances and specification. Material Selection and design, overview, the selection of materials, service conditions materials and primary processes, Secondary process, welding, machining, thermal treatment, finishing Operations.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
**Title of the Course:** Ferrous Metallurgy

**Credit Hours:** 3-0-3

**Pre-requisites:** -

**Specific Objectives of Course:** To provide in-depth knowledge of iron and steel making technology.

**Course Outline:**

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**
- Douglas Alan Fisher’ “Steel Making in America”’ United States Steel Corporation’ 2006
- Peters, D. “Ferrous Production Metallurgy” Willey

*Journals/Periodicals
World Wide Web*
Title of the Course: Non-ferrous Metallurgy
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide students in-depth knowledge of production and refining of materials.

Course Outline:
Introduction to Non Ferrous metals and its ore deposits in Pakistan, Introduction to Non- Ferrous Extractive Metallurgy its scope and importance in Pakistan, Aluminium and its ores, Preparation of Alumina, Preparation of Cryolite, Production of metallic Aluminium, Thermal process of Aluminium, Alloys production, Recovery of other values from Aluminium ores, Aluminium and its alloys, Properties, Microstructure and application. Copper and its ores, Preparation of concentrate, Extraction of Copper ores by pyrometallurgical methods, Matte smelting, Pier Smith converter, Top Blown Rotary Converter, Electrolyte and fire refining of Copper, Recovery of values such as Gold and Silver from Copper ores, Copper and its alloys, Properties and applications. Zinc and Zinc ores, General Preparation of extraction of Zinc, Roasting of Zinc concentrate, Leaching of roasted Zinc concentrate, Electrolysis of Zinc Sulphate solution, Melting of Cathodic Zinc, Production of Zinc retort and blast furnace method, Refining of Zinc, Zinc and its alloys, Properties and application. Lead and its ores, Extraction of lead, Blast roasting of lead concentrate, Blast furnace smelting of lead bullion, Recovery of aluminium and other metals from lead concentrate, Lead and its alloys, Properties microstructure and applications. Magnesium and its ores, Chromium and its ores, Extraction of magnesium and Chromium by Alumino-thermic and silico-thermic method, Refining of Magnesium and Chromium and its alloys, properties microstructure and application. Titanium and its ores, treatment of its ores concentrate, production of titanium metal by reduction with sodium and magnesium. Titanium and its alloys, properties, microstructure and applications. Refining of silicon and other semiconductor materials, Nickel, tungsten, cobalt and alloys. (Contents to be reviewed)

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
Title of the Course: **Design and Selection of Materials**
Credit Hours: 3-1-4
Pre-requisites:

**Specific Objectives of Course:** To provide in-depth knowledge of selection and applications of materials.

**Course Outline:**
Selection and applications of materials, service conditions, strength-to-density and modulus-to-density ratios, safety and reliability, quality control and quality assurance, prototypes and experimentation, cost analysis (economy) for a component, the lifecycle of materials and components., Computer applications in materials selection, Material selector, materials data resources (ASM, ASME standards and codes handbook references, websites). Ashby charts.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

Journals/Periodicals
World Wide Web
Title of the Course: Advanced Materials
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide students thorough understanding of advanced materials.

Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Scott A Guelcher and Hollinger, Jeffrey O., “An Introduction to Biomaterials”, Taylor and Francis, 2005
Title of the Course: Welding and Joining Processes  
Credit Hours: 3-1-4  
Pre-requisites:

Specific Objectives of Course: To provide knowledge of joining processes of materials.

Course Outline:  
Introduction to welding and joining, weld defects, selection of appropriate welding process, effect of heat on metals, pre-heating, stress, strain, weldability, type of joints, types of welds, filler metals, welding problems. Gas welding and equipments. Arc welding, power sources, DC and AC power sources, cables, electrodes, current and circuit polarity, electrode selection, weld deposit. TIG & MIG welding; Introduction, principles, non-consumable tungsten electrodes, gas supply and equipment, and TIG joint preparation, spot welding, electrode wire, gas supply, spray metal transfer method, CO₂ – MIG welding, MIG spot welding. Submerged arc and other shielded methods, equipment, current, flux, electrodes, atomic hydrogen welding, plasma arc welding electro slag welding under water shielded metals, arc welding, vapour shielded metal arc welding- Resistance welding, resistance spot welding, multiple spot welding, flash and upset welding, percussion welding, Thermit welding, equipment and techniques, process, ignition powder removing, the weld inspection, Other welding processes; laser welding, electron beam welding, pressure welding and ultrasonic welding. Soldering, brazing, joining of dissimilar materials, plastic welding, adhesive bonding, bonding materials, inspection and testing of weldments. Riveting and fastening processes. (Some modification required)

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
Title of the Course: Foundry Engineering
Credit Hours: 3-1-
Pre-requisites:

Specific Objectives of Course: To provide understanding of foundry process of materials.

Course Outline:
Introduction to Foundry Engineering and Practice, Scope and importance of the subject, Simple foundry plant layout, Tooling, equipment, machines and types of furnaces used in foundry, Selection of suitable moulding and core materials, Properties of moulding and core materials, Analysis, testing and control of moulding and core materials requirements.

Types and design of pattern, pattern making, shrinkage and contraction allowances, melting furnaces i.e. pit furnaces, induction melting furnaces, cupola furnaces, Casting of metals and alloys, selection and control of melting processes, control of chemical compositions, casting and fettling operation, metal gas interaction, causes of defects in casting and their remedies, inspection and quality assurance, introduction to new foundry techniques, Mold and component design, Investment casting, Use of Solidcast and Magma for modelling and simulation of solidification behaviour.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
Title of the Course: Corrosion Engineering
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To impart knowledge of corrosion protection and prevention techniques.

Course Outline:
Corrosion Engineering
Course contents: Introduction and basic definitions, EMF series and Free energy concepts, Electrochemical Cells and their types, Corrosion rate and its units, Uniform corrosion, Atmospheric corrosion, Galvanic corrosion and galvanic series, Crevice corrosion, Pitting, Intergranular corrosion and sensitization, Erosion corrosion and effect of velocity, Cavitation damage, Corrosion fatigue, Fretting, Exfoliation, Hydrogen damage and blistering, Hydrogen embrittlement, Stress corrosion cracking, Passivation, Pourbaix diagrams, Polarization and its types, Exchange current, Evans diagrams and "E-log i" plots, Tafel equations, Corrosion control by design, Inhibitors, their types and protection mechanism, Cathodic protection; theory & practical applications, Anodic protection, Coatings.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Revie and Uhlig “Corrosion and Corrosion Control” Wiley 4th Ed. 2008

Title of the Course: Materials Characterization
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course:

Course Outline:
Powder diffraction, Debye-Scherrer technique, Laue back/reflection and rotating crystal method, orientation of single crystal,. image analysis, electron diffraction, transmission electron microscopy, analytical transmission
electron microscopy, scanning electron microscopy, electron micro-probe analysis, XPS, AES, XRF, SPM, AFM, Optical characterization techniques, Wet analysis, gas analysis by mass spectrometry, Thermal characterization of materials, TGA, DTA, DSC. Spectroscopic techniques.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**


**Journals/Periodicals**

World Wide Web

**Title of the Course:** Powder Metallurgy

**Credit Hours:** 3-1-4

**Pre-requisites:**

**Specific Objectives of Course:** To provide understanding of powder metallurgy techniques.

**Course Outline:**

Lab Outline: Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

**Title of the Course:** Surface Engineering  
**Credit Hours:** 3-1-4  
**Pre-requisites:**

**Specific Objectives of Course:** To provide knowledge of surface engineering and coating techniques.

**Course Outline:**
Lab Outline: Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

Title of the Course: Advanced Steels
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of advanced steels.

Course Outline:
Introduction: Microstructure and property relationships in steels, High strength low Alloy (HSLA) steels, micro alloyed steels, stainless steels, duplex steels, high yield steels and super alloys.
Production and Processing: Classifications, production and processing principles, thermomechanical processing, advantages and limitations, TMT steels, dual phase steels, IF (interstitial-free) and ultra-low carbon steels for structural and automotive applications, ultra-low-carbon bainitic steels (ULCB), martensitic steels. Cast irons.
Special Steels: Stainless steels, nitrogen containing fine grained steels, orthopedic steels, superduplex corrosion resistant stainless steels, special steels, TRIP steels, maraging steels, tool steels, die steels, special steels for low to moderate temperature applications for nuclear and thermal power plants, heat resistance steels for superheaters, tool and die steels, processing and properties. Design and processing. Ultra-fine grain refinement in steel.

Lab Outline: Lab Manuals will be available in the concerned laboratory
Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Fracture Mechanics and Failure Analysis
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of fracture and failure analysis.

Course Outline:
Linear elastic fracture mechanics, Elastoplastic fracture mechanics, Ductile and Brittle fracture, Tensile fracture, Creep and Creep fracture, fatigue and Fatigue fracture, Fracture toughness theory ductile to brittle transition, effect of temperature, Griffith’s theory, micro-voids formation and ductile fracture, cleavage for brittle fracture, cleavage planes, crack opening displacement (COD), stress intensity factor, J integral, elastic-plastic fracture mechanics, , plane stress and plane strain fracture toughness, real time fracture toughness, fracture re-inforcement mechanisms. Fractography, differentiation among different types of fracture surfaces Root cause analysis, Case studies of failed components.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web
Title of the Course: Furnaces and Energy Conservation
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To impart knowledge of fuel and furnace used in metallurgical industry.

Course Outline:
Fuels: Classification, preparation, storage, handling, transportation. Combustion of Fuels, low and high temperature carbonisation of coal, liquid fuels, study of petroleum, knock rating. Light and heavy oils., furnace oil. Gaseous fuels, producer gas, water gas, coke oven gas and LPG. Natural gas and its viscosity, calorific intensity, octane number and Cetane number of fuel, analysis of fuel and fuel economy. Furnaces: Types of furnaces, electric, oil, gas, coal. Heat treatment furnaces vacuum furnaces and controlled atmosphere furnaces, grading of furnaces., Design and construction of furnaces, Power and energy calculations, heat transfer and insulation, temperature measurement procedures and instruments, energy management and cost effectiveness, Design of energy efficient furnaces.

Lab Outline: N/A

Recommended Books:
- Dame and King, “Fuels Technology” Edward Arnold, 2000

Journals/Periodicals
World Wide Web

Title of the Course: Mineral Processing
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide knowledge of mineral processing.

Course Outline:

**Lab Outline:** N/A

**Recommended Books:**
- M. C. Fuerstenau, & N. Han, Kenneth “Principles of Mineral Processing”. Society for Mining Metallurgy & Exploration, 2003

**Journals/Periodicals**
World Wide Web

**Title of the Course:** BIOMATERIALS  
**Credit Hours:** 3-0-3  
**Pre-requisites:**

**Specific Objectives of Course:** To impart knowledge related Biomaterials.

**Course Outline:**
Introduction and classification, biocompatibility and bioactivity, organic materials processing and synthesis, surfactants, hydroxyapatite (HA) coatings, Total Hip Joint and Knee Joint Replacement implants, materials selection for implants and prostheses, dental materials, enamels, hard and soft tissue regeneration, Transplants, Tribology of human joints Ti alloys and shape memory alloys Bio and Tissue Engineering

**Lab Outline:** N/A

**Recommended Books:**
- Jeffrey O. Hollinger, An Introduction to Biomaterials, 2nd Edition (Biomedical Engineering, CRC Press 2011
Title of the Course: Nuclear Materials  
Credit Hours: 3-0-3  
Pre-requisites: 

Specific Objectives of Course: To impart knowledge on nuclear materials.

Course Outline:  

Lab Outline: N/A

Recommended Books:  
• Hemsworth “Nuclear Materials” Nova science PUB inc. 2011  
• The American Society of Mechanical Engineers, “Performance and Evaluation of Light Water Reactor Pressure Vessels”, 1987

Title of the Course: Vacuum Technology  
Credit Hours: 3-0-3  
Pre-requisites: 

Specific Objectives of Course: To impart knowledge on vacuum techniques used in the field of materials and metallurgy.

Course Outline:  
Vacuum technology: Different units of measuring pressure vacuum regimes, mean free path, collision frequency. Vacuum pumps: Water pumps, positive displacement pumps, rotary and roots pump, vapour ejector and vapour entrainment pumps, diffusion pump, turbo-molecular pump, ion pumps, sieve

Vacuum Coatings: Introduction, purpose of vacuum coating, process of vacuum coating, vacuum coating system by electro bio-bombardment beating, valves used in vacuum technology.

**Lab Outline:** N/A

**Recommended Books:**

**Journals/Periodicals**
**World Wide Web**

**Title of the Course:** Composite Materials  
**Credit Hours:** 3-1-4  
**Pre-requisites:**

**Specific Objectives of Course:** To provide knowledge of composite and polymeric materials.

**Course Outline:**
Introduction to Composite materials, Metal matrix composites MMCs), Polymer matrix composites (PMCs), Ceramic matrix composites (CMCs), classification characteristics, mechanical behaviour potential advantages, properties and applications. Composite material design, specific stiffness and strength, and recent developments such as metal matrix composite, ceramic matrix composites, carbon fibre reinforced composite, Manufacturing and processes for fibres and other reinforcements, polymeric matrix composites, processing principles and design of ply and laminate structures, filament winding and pultrusion.
Recommended Books:
- Mathew and Rowling ‘Composite Materials’

New course: Polymeric Materials

Survey and classification of polymeric materials. Review of polymer chemistry, introduction to polymers, classification of polymers, polymerisation, co-polymerisation, structure and properties of thermoplastic and thermosetting polymers, elastomers and rubber, vulcanisation, additives and fillers. Manufacturing, properties and applications of polymers, polystyrene, polybutadiene, polyester, polymethyl methacrylate (PMMA), nylon 6:6, acrylonitrile-butadiene-styrene (ABS), silicon resin, epoxy resin, phenol-formaldehyde and other advanced polymers, forming processes, testing and identification of polymers, fibres, foams and adhesives, Plastics, conductive polymers and plastics.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- McCrum, N. G. and Buckley, C., “Principles of Polymer Engineering”, OUP, 2002
- Rodger, Brendan, “Rubber Compounding: Chemistry and Applications”, Taylor and Francis, 2004
- Linda C. Sawyer, David T. Grubb, Gregory Frederick Meyers / 2008/ Springer, Polymer microscopy
Title of the Course:  Senior Design Project Part-1
Credit Hours: 0-9-3
Pre-requisites:

Specific Objectives of Course: To provide students learning of research techniques used in the industry.

Course Outline:
Selected problems from the industry and current materials research issues regarding selection processing, designing, manufacturing and development. Fabrication of prototype/models and laboratory experimentation shall be assigned to individual students/ Grading shall be the reports produced by individual students and their evaluation through an oral examination

Lab Outline: Experimental work will be carried out in the relevant laboratories/industry according to the nature of the project

Recommended Books:
Reference book and journal for latest literature survey and methodology

Title of the Course:  Senior Design Project Part-1I
Credit Hours: 0-9-3
Pre-requisites:

Specific Objectives of Course: Same as Part-I

Course Outline:
Same as Part-I
Lab Outline: Experimental work will be carried out in the relevant laboratories/industry according to the nature of the project

Recommended Books:
Reference book and journal for latest literature survey and methodology
MANAGEMENT COURSES

ENTREPRENEURSHIP AND MARKETING

Course Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Course Contents:

Introduction: The concept of entrepreneurship, the economist view of entrepreneurship, The sociologist view, Behavioural approach, Entrepreneurship and Management

The Practice of Entrepreneurship: The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture

Entrepreneurship and Innovation: The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation

Developing Entrepreneur: Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems

Entrepreneurship Organization: Team work, Networking organization, Motivation and compensation, Value system

Entrepreneurship and SMES: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs

Entrepreneurial Marketing: Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

Entrepreneurship and Economic Development: Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience
Case Studies of Successful Entrepreneurs

Text Books:
- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
- P.N. Singh: Entrepreneurship for Economic Growth
- Peter F. Drucker: Innovation and Entrepreneurship
- John B. Miner: Entrepreneurial Success

Entrepreneurship and Marketing (3-0-3): Industrial economic strategy, preparation of a business plan for new ventures and financing options for start-up businesses, barrier to entry, corporate governance and mergers. Information gained through environmental scans on new business opportunities, case studies, sharing the experiences of entrepreneurs and investors, consulting for or inventing in start-up or entrepreneurial businesses and for professionals.

Recommended Books:
- Entrepreneurship by Hisrich, McGraw Hill, 2009

MM494 Engineering Management (3-0-3): Industrial networks, fundamentals of product and process development, business community and new generations of managers, practical skills, knowledge and experience in commercialization of new technological inventions, use of multidisciplinary science based knowledge, problem-solving, teamwork, outreach activity, major steps in proof of concept to intellectual property protection, prototype development, fabrication and assembly routes, materials procurement, identification and creation of new markets, development of business plan, appropriate technology and marketing, distribution and financing, routes and strategies for specific technology under development.

Recommended Books:

PRINCIPLES OF MANAGEMENT

Course Objectives:
This is a rudimentary course for the students of business administration. The focus of attention will be given to learning fundamental principles of management and of
managing people and organization in a historical as well as contemporary world. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

**Course Contents:**
- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system and process and techniques of controlling
- Management and Society: future perspective

**Text Books:**
- Stephen P. Robins, Mary Coulter: Management
- H. Koontz Odonnel and H. Weihrich: Management
- Mc Farland: Management: Foundation and Practice

**Nanotechnology (3-0-3):** dimensional materials, nanoscale synthesis (bottom-up), production of nanoparticles and clusters, quantum wells and dots, nanowires, nanorods, and nano-multilayered structures, CNTs, self assembly and catalysts, bulk nanomaterials, nanomaterials handling, safety and precautions, special characterization methods for nanomaterials and advanced surfaces, unique physical, chemical and mechanical properties, nano-bio-info-materials, nanodevices, nanotechnology and its prospects for industry.

**Recommended Books:**
Nanoscale Science and Technology by Kelsall, Hamely & Geoghegan Wiley (2005)
Introduction to nanotechnology by Poole and Owens, publ: John Wiley, 2003
Handbook of nanotechnology by Bhushan, Springer, 2003
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<th>Lab #</th>
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<td>Stereographic Projections (geometric exercises)</td>
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<td>III</td>
<td>Introduction to XRD Technique &amp; Equipment * + Rolling Video</td>
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### Obtaining Diffraction Pattern from a known Material & Interpretation of Results

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### Identification of an Unknown Material by X-Ray Powder Diffraction Film

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### Size distribution of foundry sand.

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### Annealing, normalising and quenching and tempering of steel.

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### Identification of polymers using various chemicals and physical methods.

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### Injection moulding of polymers.

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### To study the atomic arrangement, lattice defects and deformation behaviour using a bubble raft model.

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### Testing of moulding sand.

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### Casting by split and single piece patterns.

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### To study the effect of annealing, normalizing and quenching and tempering on tensile properties of mild steel.

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### To study the effect of cooling media on the structure and hardness of steel.

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### Anisotropy in tensile properties of deformed materials.

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### Recovery, recrystallisation and grain growth

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### Tensile test of polymeric materials.

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### Casting of a metal / alloy using centrifugal casting process.

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### To study the effect of strain rate on tensile strength of different polymers.

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### Age hardening behavior of alloys.

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### Strain aging behavior of mild steel.

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### Intercritical heat treatment of mild steel.

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### To study the effect of embrittlement in steel and cast iron by notched bar impact test.

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### Determination of Tg and Tm of polymers.

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### Casting of metals using carbon dioxide-sodium silicate process for mold making.

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### Autempering of steel.

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### Analysis of polymers using Fourier Transformed Infra-red Spectroscopy.

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### Jominy end quench hardenability test.

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### Fatigue test of mild steel.

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### Study of Investment casting process and casting a metal / alloy.

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### Casting and Microstructural examination of lead-tin alloys.

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### Electrowinning of Copper From CuSO solution.

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### Cast and Rheocast Aluminum alloys, properties and microstructures

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<td>3 Point Bend Test of Polymer Matrix Composite Materials</td>
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<td>Potentiodynamic study of mild steel in 3.5% NaCl solution using Research Potentiostat and Sweep Generator</td>
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<td>Diodes: Materials Use, Application and Forward Biased and Reverse Biased Characteristics of Silicon and Germanium Diodes</td>
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<td>Mixing and cold pressing of Aluminium and Aluminium - Silicon Carbide (e.g. Al - SiC) powder.</td>
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<td>Selective Leaching of Brass and Microstructural Examination</td>
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<td>Part B: Tensile Testing of Polymer Matrix Composite Materials.</td>
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<td>Power Cables: Applications, Types and Material Selection.</td>
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<td>Materials, components and working of optical fibres</td>
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<td>Part B: Determination of resistance characteristics of thermistors with temperature, its materials and applications.</td>
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<td>Measurement of electrical conductivity at low temperatures.</td>
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Graduate Programme

MS Degree Programme in Metallurgy and Materials Engineering

The MS and PhD Programs in Materials Engineering are diverse to cover the wide range of areas of active research and field of specialization such as advanced materials, manufacturing, metallurgical processes, structural properties, new materials, biomaterials and nanomaterials. The criteria and outline of courses are described for adoption as broad guidelines.

MS Degree Programme 4-Semester Duration (02 Years)

**Option 1:**
Course Work: 24 CH
MS Thesis: 6 CH

**Option 2:**
MS Course work: 30 CH
Total CH: 30

Core courses are mandatory for MS degree in Materials Engineering

Minimum 3 Core Courses are Requirement:

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<tbody>
<tr>
<td>Materials Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mechanical Behaviour of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Phase Transformations</td>
<td>3</td>
</tr>
<tr>
<td>Open (depending on the choice of the institute/ department)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Elective Courses:**

Elective Requirement (4)

Minimum Four (4) Courses can be selected from the listed given below:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of Dislocations</td>
<td>3</td>
<td>Advanced Coating technology</td>
<td>3</td>
</tr>
<tr>
<td>Fracture mechanics and Failure Analysis</td>
<td>3</td>
<td>Surface analysis and characterization</td>
<td>3</td>
</tr>
<tr>
<td>Metal Forming</td>
<td>3</td>
<td>Tribology Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Thermo-mechanical Processing</td>
<td>3</td>
<td>Thin Film Technology</td>
<td>3</td>
</tr>
<tr>
<td>Micro structural Control</td>
<td>3</td>
<td>Carbon Materials</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Manufacturing Systems</td>
<td>3</td>
<td>Polymer Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Joining Technology</td>
<td>3</td>
<td>Advance Ceramics Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Nanomaterials</td>
<td>3</td>
<td>Electronic Materials</td>
<td>3</td>
</tr>
<tr>
<td>Course</td>
<td>Credits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Smart Materials</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic Materials</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Materials</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synthesis and Design of Nanostructures and Devices</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Composite Materials</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advances in Extractive Metallurgy</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nanomaterials and Computer Aided Nano-design</td>
<td>3</td>
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<tr>
<td>Solidification</td>
<td>3</td>
<td></td>
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<tr>
<td>Electron Microscopy</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance Characterization Techniques</td>
<td>3</td>
<td></td>
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<tr>
<td>X-Ray Diffraction and Texture Studies</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modelling of Material Processing</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modern Steels and Processes</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powder Metallurgy</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomaterials</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computational Materials Engineering</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrosion monitoring and prevention</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical Methods in Engineering/Computational Methods for Engineers</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Science and Engineering</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Management</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Interfaculty Electives:
- Student may have option to register one Interfaculty course.

**PhD Degree Programme in Metallurgy and Materials Engineering**

PhD Degree Programme (Minimum 3 Years)

<table>
<thead>
<tr>
<th>Total number of credits</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course work credits</td>
<td>18</td>
</tr>
<tr>
<td>Dissertation</td>
<td>12</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS

After thorough deliberations the committee proposed the following recommendations:

The committee is of the view that the field of metallurgy and materials engineering can contribute in the national development and support the industry and R&D institutions.

1. The Universities should be facilitated to impart quality education and produce engineers who are capable to undertake research and industrial assignments and pursue higher studies.

2. The curriculum designed should guide the universities and relevant departments offering this program to meet the minimum benchmark for the Bachelor degree programme in Metallurgy and Materials Engineering. The study program should have 65-70% engineering courses and 30-35% of non-engineering courses, the curriculum should be revised after every three years.

3. HEC should review the functional English language courses to include technical report writing, thesis and communication skills.

4. Universities should have plan for providing opportunities to students for preferable internship programme and offer final year projects also relevant to industrial needs.

5. HEC must facilitate local printing of low priced editions of internationally acclaimed text books recommended for the programme, availability of lab equipment and Software relevant to the field of metallurgy and materials engineering.

6. HEC should support and encourage utilization of facilities located at various universities across the country.

7. HEC should arrange resources for video-conferencing and lectures sharing amongst the departments offering this program.

8. All the universities/institutions offering this programme must focus on developing industrial linkages and international collaborations with foreign universities.

HEC should review the faculty development programme to allocate more funding to increase scholarships in this field of metallurgy and materials engineering.
COMPULSORY COURSES IN ENGLISH FOR BE/BSc IN ENGINEERING DISCIPLINE

Semester – I

**Functional English**

**Objectives:** To enhance language skills and develop critical thinking

**Course Contents**

- Basics of Grammar
- Parts of speech and use of articles
- Sentence structure, Active and passive voice
- Practice in unified sentence
- Analysis of phrase, clause and sentence structure
- Transitive and intransitive verbs
- Punctuation and spelling

**Comprehension**

Answers to questions on a given text

**Discussion**

General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

**Listening**

To be improved by showing documentaries/films carefully selected by subject teachers

**Translation skills**

Urdu to English

**Paragraph writing**

Topics to be chosen at the discretion of the teacher

**Presentation skills**

Introduction

**Note:** Extensive reading is required for vocabulary building

**Recommended Books:**

1. **Functional English**
   a) **Grammar**

b) Writing

c) Reading/Comprehension

d) Speaking

Semester II

Communication Skills

Objectives: To enable the students to meet their real life communication needs

Course Contents:

Paragraph writing
Practice in writing a good, unified and coherent paragraph

Essay writing
Introduction

CV and job application

Translation skills
Urdu to English

Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills
Letter / memo writing and minutes of the meeting, use of library and internet recourses

Presentation skills
Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review
Recommended books:
Communication Skills

a) Grammar

b) Writing

c) Reading
   2. Reading and Study Skills by John Langan

Semester III

Technical Writing and Presentation Skills

Objectives: To enhance language skills and develop critical thinking

Course Contents:

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing
Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing
      (particularly suitable for discursive, descriptive, argumentative and report writing).

b) Presentation Skills

c) Reading
   Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth
   century literature, without taxing the taste of engineering students).

Semester III

Technical Writing and Presentation Skills

Objectives: To enhance language skills and develop critical thinking

Course Contents:

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended Books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing


d) Presentation Skills
e) Reading
   The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).
## ISLAMIC STUDIES (Compulsory)

### COURSE PROFILE

<table>
<thead>
<tr>
<th>S.NO</th>
<th>TITLES</th>
<th>DETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name of Course</td>
<td>Islamic Studies (Compulsory)</td>
</tr>
<tr>
<td>2</td>
<td>No. of Credit Hours</td>
<td>2 Credit Hours</td>
</tr>
<tr>
<td>3</td>
<td>Nature of Course</td>
<td>Compulsory at Graduation Level</td>
</tr>
<tr>
<td>4</td>
<td>Total Teaching Weeks</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Objectives of the Course</td>
<td>This course is aimed at:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1- To provide Basic information about Islamic Studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2- To enhance understanding of the students regarding Islamic Civilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3- To improve Students skill to perform prayers and other worships</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4- To enhance the skill of the students for understanding of issues related to faith and religious life</td>
</tr>
<tr>
<td>6</td>
<td>Components of Teaching of the Course</td>
<td></td>
</tr>
</tbody>
</table>

### LEVEL OF COURSE

<table>
<thead>
<tr>
<th>NAME OF COURSE</th>
<th>BS</th>
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<tbody>
<tr>
<td>NAME OF DEGREE</td>
<td>ISLAMIC STUDIES</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>AS PER REQUIREMENT OF THE UNIVERSITY</td>
</tr>
<tr>
<td>NO. OF CREDIT</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL TEACHING HOURS</td>
<td>AS PER HEC REQUIREMENTS</td>
</tr>
<tr>
<td>NO. OF PERIODS PER WEEK</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL TEACHING PERIOD OF COURSE</td>
<td>18 WEEKS</td>
</tr>
</tbody>
</table>

**UNIT NO.1: INTRODUCTION TO QURANIC STUDIES**

1) Basic Concepts of Quran  
2) History of Quran  
3) Uloom-ul -Quran

**UNIT NO.2: STUDY OF SELECTED TEXT OF HOLLY QURAN**

1) Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)  
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi
UNIT NO.3: STUDY OF SELECTED TEXT OF HOLLY QURAN
1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

UNIT NO.4: SEERAT OF HOLY PROPHET (S.A.W) I
1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

UNIT NO.5: SEERAT OF HOLY PROPHET (S.A.W) II
1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

UNIT NO.6: INTRODUCTION TO SUNNAH
1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

UNIT NO.7 SELECTED STUDY FROM TEXT OF HADITH

UNIT NO.8 INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE
1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

UNIT NO.9: ISLAMIC CULTURE & CIVILIZATION
1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

UNIT NO.10: ISLAM & SCIENCE
1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quran & Science

UNIT NO.11: ISLAMIC ECONOMIC SYSTEM
1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

UNIT NO.12: POLITICAL SYSTEM OF ISLAM
1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

UNIT NO.13: ISLAMIC HISTORY
1) Period of Khlaft-e-Rashida
2) Period of Ummayyads
3) Period of Abbasids

UNITNO.14 : SOCIAL SYSTEM OF ISLAM
1) Basic Concepts of Social System of Islam
2) Elements of Family
3) Ethical Values of Islam

REFERENCE BOOKS:
1) Hameed Ullah Muhammad, “Emergence of Islam”, Iri, Islamabad
2) Hameed Ullah Muhammad, “Muslim Conduct of State”
3) Hameed Ullah Muhammad, ‘Introduction to Islam
4) Mulana Muhammad Yousaf Islahi, ”
6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, international Islamic University, Islamabad (1993)
9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)
Pakistan Studies (Compulsory)

(As Compulsory Subject for Degree Students)

Introduction / Objectives:
The course has been designed as a compulsory subject for the students studying for Bachelor’s degree, general or professional. The course is of 3 credit hours carrying 100 marks (recommended). The teaching work is comprised of three dimensions: Historical Perspective (20%); Government and Politics (40%); and Contemporary Pakistan (40%). The course framework is issue-oriented. It has many dimensions, the historical and ideological background of Pakistan the process of governance and national development as well as the issues arising in the modern, age and posing challenges to Pakistan. The course has been designed with a vision that Pakistan Studies should open a window to future.

Course Outline:

1. Historical Perspective
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and Geo-Physical features.

2. Government and Politics in Pakistan
   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

3. Contemporary Pakistan
   a. Economic institutions and issues
   b. Society and social structure
   c. Ethnicity
   d. Foreign policy of Pakistan and challenges
   e. Futurist outlook of Pakistan
Recommended Books:
Objectives: The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from subordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

1. Introduction to Sociology
   1.1 What is sociology?
   1.2 Nature, Scope, and Importance of Sociology
   1.3 Social Interactions
   1.4 Social Groups
   1.5 Social Institutions

2. Culture and Related Concepts
   2.1 Definition of Culture
   2.2 Types of Culture
   2.3 Elements of Culture
   2.4 Role of Culture in Organization
   2.5 Socialization and Personality

3. Interpersonal Relations
   3.1 Interpersonal Behaviour
   3.2 Formation of Personal Attitudes
   3.3 Language and Communication
   3.4 Motivations and Emotions
   3.5 Public Opinion

4. Social Stratification
   4.1 Factors of Social Stratification
   4.2 Caste and class
   4.3 Power, Prestige, and Authority
   4.4 Social Mobility
   4.5 Migration
5. Human Ecology
   5.1 Ecological Processes
   5.2 Ecosystem and energy
   5.3 Ecosystem and Physical Environment
   5.4 Solid Waste Disposal
   5.5 Pollution

6. Population Dynamics
   6.1 World Population Growth and Distribution
   6.2 Population Dynamics in Pakistan
   6.3 Causes and Consequences of Urbanization
   6.4 Population Policy in Pakistan
   6.5 Population and Development

7. Community Development
   7.1 Meaning, Scope, and Subject Matter of Community Development
   7.2 Processes of Community Development
   7.3 Community Development Programs in Pakistan
   7.4 Community Organization and Related Services
   7.5 Cooperation and Conflict in Community Development

8. Deviance and Crime
   8.1 Crime as a Social and Cultural Phenomenon
   8.2 Crime and Social Organization
   8.3 Organized Crime
   8.4 Culture Based Crime
   8.5 Economics of Crime

9. Sociology of Change and Development
   9.1 What is Social Change and Development?
   9.2 Dynamics of Social Change
   9.3 Role of NGOs in Development
   9.4 World System and Development
   9.5 Gender and Development

Recommended Readings

SOCIAL ANTHROPOLOGY
(For Engineers)

Objectives: The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

I Introduction
1. Anthropology and Social Anthropology
2. Fields of Anthropology
3. Anthropological Research Methods
4. Social Anthropology and other Social Sciences
5. Significance of Social Anthropology

II Culture
1. Definition, Properties and Taxonomy
2. Evolution of Growth and Culture
3. Evolution of Man: Religious and Modern Perspectives
4. Evolution of Culture
5. Culture and Personality

III Evolution and Growth of Culture
1. Evolution of Man
2. Schools of Thought in Cultural Anthropology
3. Acculturation
4. Enculturation
5. Ethnocentrism and Xenocentrism

IV Language and Culture
1. Communication
2. Structural Linguistics
3. Historical Linguistics
4. Relationship between Language and Culture
5. Ethnography

V Economic System
1. Global Economic System
2. The Allocation of Resources
3. The Conversion of Resources
4. The Distribution of Goods and Services
5. Poverty and Inequality

VII Marriage and Family
1. Marriage and Mate Selection
2. The Family: Types and Functions
3. Kinship System
4. Structure and Function of Family
5. Gender Relations

VIII Political Organization
1. Political Sociology
2. Origin of Political Organization and Organizational System
3. Types of Political Organizations
4. Power Politics and Factionalism in Pakistan
5. Resolution of Conflict

IX Religion and Magic
1. The Universality of Religion
2. Comparative Religions
3. Religion and Society
4. Religious Beliefs and Practices
5. Witchcraft and Sorcery

XI Culture Change
1. Forms of Art
2. Expressive Culture
3. Process of Cultural Change
4. Cultural Change in the Modern World
5. Cultural Change in Pakistani society

Recommended Books:
Psychology courses for BSc/B.E in Engineering Programme

Course-I Understanding Psychology and Human Behaviour 3 credit hrs

- What is Psychology?
- Nature, Scope and Application with Special Reference to Pakistan
- Different Schools of Psychology
- Methods of Psychology
- Learning
- Intelligence and Artificial Intelligence
- Personality and its Assessment
- Understanding Maladjustive Behaviour
- Positive Emotional States and Processes
- Stress Management and Anger Management

Recommended Books:


Course II  Professional Psychology  3 credit hrs
- Introduction to Professional Psychology
- Psychological Testing
- Educational Psychology
- Industrial/Organizational Psychology
- Social Psychology
- Health Psychology
- Clinical Psychology
- Positive Psychology
- Legal, Ethical, and Professional Issues.

Books Recommended:

PROFESSIONAL ETHICS

Course Description:

Prerequisite: None
Co-requisite: None

This course introduce contemporary and controversial ethical issues facing the business community. Topics include moral reasoning, moral dilemmas, law and morality, equity, justice and fairness, ethical standards, and moral development. Upon completion, students should be able to demonstrate an understanding of their moral responsibilities and obligations as members of the workforce and society.

Course Objectives:

At the completion of the course requirements, the student will be able to:
   a. Define business ethics
   b. Describe the evolution of business ethics
   c. Describe major ethical perspectives
   d. Understand and apply an ethical decision-making framework
   e. Understand social responsibility from several dimensions
   f. Understand how the organization influences ethical decision-making
   g. Examine how significant others influence ethical decision-making
   h. Develop an effective ethics programme.
   i. Understand international business ethics.

Course Outline:

Ethical issues in Business: Foundation of Ethical Conflict, Classifications of Ethical Issues, Ethical Issues Related to Participants and Functional Areas of Business, Recognizing an Ethical Issue.

Applying Moral Philosophies to Business Ethics: Moral Philosophy Defined, Moral Philosophy Perspectives.


The Role of Opportunity and Conflict: Opportunity, Conflict.


International Business Ethics: Ethical Perceptions and International Business, Culture As a Factor in Business, Adapting Ethical Systems to a Global Framework: Cultural Relativism, the Multinational Corporation, A universal Set of Ethics, Ethical Issues Around the Globe.

Text Books:

ORGANIZATIONAL BEHAVIOUR 3 Credit Hrs

- Introduction to Organizational Behaviour
  - Organizational Disciplines and topics
  - Psychological Perspective
  - Social-Psychological Perspectives
• Structure and Control in Organization
  o Introduction
  o Bureaucracy
  o Managerial Work
  o Contingency theory
  o Organizational Design

• Individual and Work Learning
  o Learning Theories
  o Learning and Work

• Stress
  o Types of Stress and Work
  o Occupational Stress Management

• Individual Differences
  o Personality and its factors
  o Personality dimensions and social learning
  o Intelligence

• Motivation and Job Satisfaction
  o Needs at Work
  o Theories of Motivation and job satisfaction
  o Correlates of Job satisfaction
  o Correlates of Job satisfaction

• Group and Work
  o Social Interaction
  o Dramaturgy and impression Management
  o Social Skill

• Group and Inter group Behaviour
  o Group Structure & Norms
  o Group Processes
  o How throne Studies

• Leadership
  o Leadership as an attribute
  o Leadership Style

• Patterns of Work
  o Work-the classical approach
  o Marx, Weber, & The critique of labor
  o Foucault & Disciplinary Power
• Conflict and Consent in Work
  o The labor Process debate
  o Work place control and resistance
  o Industrial conflict and industrial relations

• Organizational culture
  o Organizational culture and strategic management
  o Exploring organizational culture
  o Evaluating concept of culture

Recommended Books

INTRODUCTION TO SOCIOLOGY    3 Credit Hrs

• The Nature of Sociology
  o The study of social life
  o Exploring the global village
  o Sociology as a science
  o The Sociological imagination
  o The development of Sociology
  o Pioneers of Sociology
  o Nature, scope and subject matter of Sociology
  o Brief historical development of Sociology
  o Society and community
  o Relationship with other social sciences
  o Social Interaction Processes

• Social groups
  o Definition and functions
  o Types of social groups

• Social institutions
  o Definition
  o Structure and function of social institutions
  o Inter-relationships among various social institutions
Culture and related concepts
- Definition and aspects of culture
- Elements of culture
- Organization of culture
- Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag

Socialization and personality
- Role and status
- Socialization
- Culture and personality

Deviance and social control
- Definition and types of deviance
- Juvenile delinquency
- Formal and information methods of social control

Social stratification
- Approach to study social stratification
- Caste class and race as basics of social stratification

Major perspectives in Sociology
- Functionalist perspective
- Conflict perspective
- Interactionistic perspective

Social Control and deviance
- Agencies of social control

Social stratification
- Determinants of social stratification
- Social mobility, types and definition
- Dynamics of social mobility

Concept of social movement
- Theories of social movement
- Social and cultural change

Social and cultural change
- Definition of social change
- Dynamics of social change
- Impact of globalization on society and culture
- Resistance to change

Collective behaviour
- Definition
- Characteristics
- Causes
- Types
- Social movements
- Mob and crowd behaviour

**Books Recommended:**

**CRITICAL THINKING 3 Credit Hrs**

- The Power of Critical Thinking
  - Claims and Reasons
  - Reasons and Arguments
  - Arguments in the Rough
- The Environment of Critical Thinking
  - Perils of Haunted Mind
  - Self and the Power of the Group
  - Subjective and Social Relativism
  - Skepticism

- Making Sense of Arguments
  - Arguments Basics
  - Patterns
  - Diagramming Arguments
  - Assessing Long Arguments

- Reasons for Belief and Doubt
  - Conflict Experts and Evidence
  - Personal Experience
  - Fooling Ourselves
  - Claims in the News

- Faulty Reasoning
  - Irrelevant Premises
  - Genetic Fallacy, Composition, Division
  - Appeal to the Person, Equivocation, Appeal to Popularity
  - Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
  - Red Herring, Straw Man
• Unacceptable Premises
  o Begging the Question, False Dilemma
  o Slippery Slope, Hasty Generalization
  o Faulty Analogy

• Deductive Reasoning: Propositional Logic
  o Connectives and Truth Values
  o Conjunction, Disjunction, Negation
  o Conditional, Checking for Validity
  o Simple Arguments, Tricky Arguments
  o Streamlined Evaluation

• Deductive Reasoning: Categorical Logic
  o Statements and Classes
  o Translations and Standard Form
  o Terms, Quantifiers
  o Diagramming Categorical Statements
  o Sizing up Categorical Syllogisms

• Inductive Reasons
  o Enumerative Induction
  o Sample Size, Representativeness, Opinion Polls
  o Analogical Induction
  o Casual Arguments, Testing for Causes
  o Casual Confusions

• Inference to the Best Explanation
  o Explanations and Inference
  o Theories and Consistency
  o Theories and Criteria
  o Testability, Fruitfulness, Scope, Simplicity
  o Conservatism

• Judging Scientific Theories
  o Science and Not Science
  o The Scientific Method, Testing Scientific Theories
  o Judging Scientific Theories
  o Copernicus versus Ptolemy, Evolution Versus Creationism
  o Science and Weird Theories
  o Making Weird Mistakes
  o Leaping to the Weirdest Theory, Mixing What Seems with What is
  o Misunderstanding the Possibilities
  o Judging Weird Theories
  o Crop Circles, Talking with the Dead
RECOMMENDED BOOKS:

INTRODUCTION TO PHILOSOPHY 3 Credit Hrs

- Definition and Nature of Philosophy
- Theory of Knowledge
  - Opinion and Knowledge
  - Plato, the Republic Selection
  - Knowledge through Reason
  - Descartes Meditation on First Philosophy
  - Knowledge through Experience
  - Hume an Inquiry concerning Human Understanding (Selection)
  - Experience Structured by the Mind
  - Kant Critique of Pure Reason (Selection)
  - Knowing and Doing
  - James Pragmatism (Selection)
  - Knowledge and Emotion
  - Jaggar Love and Knowledge (Selection)

- Philosophy of Religion
  - Proving that Existence of God
  - Anselm, Aquinas, Paley, Dawkins (Selection)
  - Justifying Religious Beliefs
  - Pascal Pensees (Selection)
  - James The will to Believe Selection
  - Freud The Future of an Illusion (Selection)
  - Confronting the Problems of Evil
  - Mackie Evil and Omnipotence (Complete)
  - Hick Philosophy of Religion (Selection)

- Metaphysics
  - Idealism and Materialism
  - Berkeley Three Dialogues Between Hylas and Pholonous (Selection)
  - Armstrong Naturalism, Materialism and First Philosophy (Selection)
  - The Mid-Body Problem
  - Descartes Meditations on First Philosophy (Selection)
  - O'Hear Introduction to the Philosophy of Science (Selection)
  - Dennett The Origins of Selves (Complete)
  - Pali Canon (Selection)
  - Penelhum Religion and Rationality (Selection)
- Freedom to Choose
  - Libertarianism
  - James The Dilemma of Determinism (Selection)
  - Taylor Metaphysics (Selection)
  - Determinism
  - Hospers Meaning and Free Will (Selection)
  - Skinner Walden Two (Selection)
  - Compatibilism
  - Stace Religion and the Modern Mind (Selection)
  - Radhakrishnan Indian Philosophy (Selection)

- Ethics
  - Fulfiling Human Nature
  - Aristotle Nicomachean Ethics (selection)
  - Loving God
  - Augustine The Morals of the Catholic Church and the City of God (Selection)
  - Following Natural Law
  - Aquinas Summa Theologiae (Selection)
  - Doing One’s Duty
  - Kant Fundamental Principles of the Metaphysics of Morals (Selection)
  - Maximizing Utility
  - Mill Utilitarianism (Selection)
  - Turning Values of Upside Down
  - Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
  - Creating Ourselves
  - Sartre Existentialism is a Humanism (Selection)
  - Hearing the Feminine Voice
  - Gilligan In a Different Voice (Selection)
  - Baier What do Women Want in a Moral Theory (Selection)

- Political and Social Philosophy
  - The State as Natural
  - Plato the Republic (Selection)
  - Aristotle Politics (Selection)
  - The State as a Social Contract
  - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - Locke the Second Treatise of Government (Selection)
  - Liberty of the Individual
  - Mill On Liberty (Selection)
  - Alienation in Capitalism
  - Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - Justice and Social Trust
- Rawls A Theory of Justice (Selection)
- Nozick Anarchy, State, and Utopia (Selection)
- Held Rights and Goods (Selection)
- Women in Society
- Wollstonecraft A Vindication of the Rights of Women (Selection)
- De Behaviour The Second Sex (Selection)
- The Value of Philosophy
- Russel The Problems of Philosophy (Selection)
- Midgley Philosophical Plumbing (Selection)

**RECOMMENDED BOOKS:**
